Proposal of Integrated Marine Ecological Management in Beibu Gulf for Sino-US Cooperation

as submitted by Chinese State Oceanic Administration

July 2000

FIRST DRAFT

In 28 and 29 of June 2000, the Export Groups from the State Oceanic Administration (SOA) of the People's Republic of China and the National Ocean Service (NOS) of the United States of America co-sponsored the Workshop of Long-term Projects of Coastal and Ocean Management for Sino-US Cooperation in Nanning in accordance with the Summaries of it Second Workshop. According to the intentions agreed upon in the Workshop, both parties considered the Beibu Gulf a more suitable candidate area for the long-term project and preliminarily decided some sub-projects in the Proposal of Long-term Project and relevant working agenda. The Oceanic Administration accordingly organized some experts to revise and perfect the Proposal of Integrated Ecological Management in the Beibu Gulf, which was submitted in the Workshop. The Proposal is submitted as below for the studies of the NOS and IUCN experts.

1.**Properties and Scope of the Project**

The candidate area for the long-term project is in the eastern part of the Beibu Gulf along Guangxi coast (20°54′_22°28′N, 107°29′_109°46′E (See, Fig. 1., for coordination see the part of each specific sub-project). The major objectives are to carry out integrated ecological management in coastal Guangxi for protecting marine resources and maintenance of marine ecological environments and the sustainable development of ocean economy by making use of international funds and technical forces and by making use of foreign advanced management experiences and management concepts and technologies.

Fig. 1 A Sketch Map of Beibu Gulf

2.Profile of Economy in the Project Area

Both economy and urban construction have been developing rather rapidly in the past years in coastal Guangxi where the project is proposed to be implemented. However, in a general view, it is at a lower development stage as it is an area with agriculture as its dominant industry. In marine industry, marine fishery has the

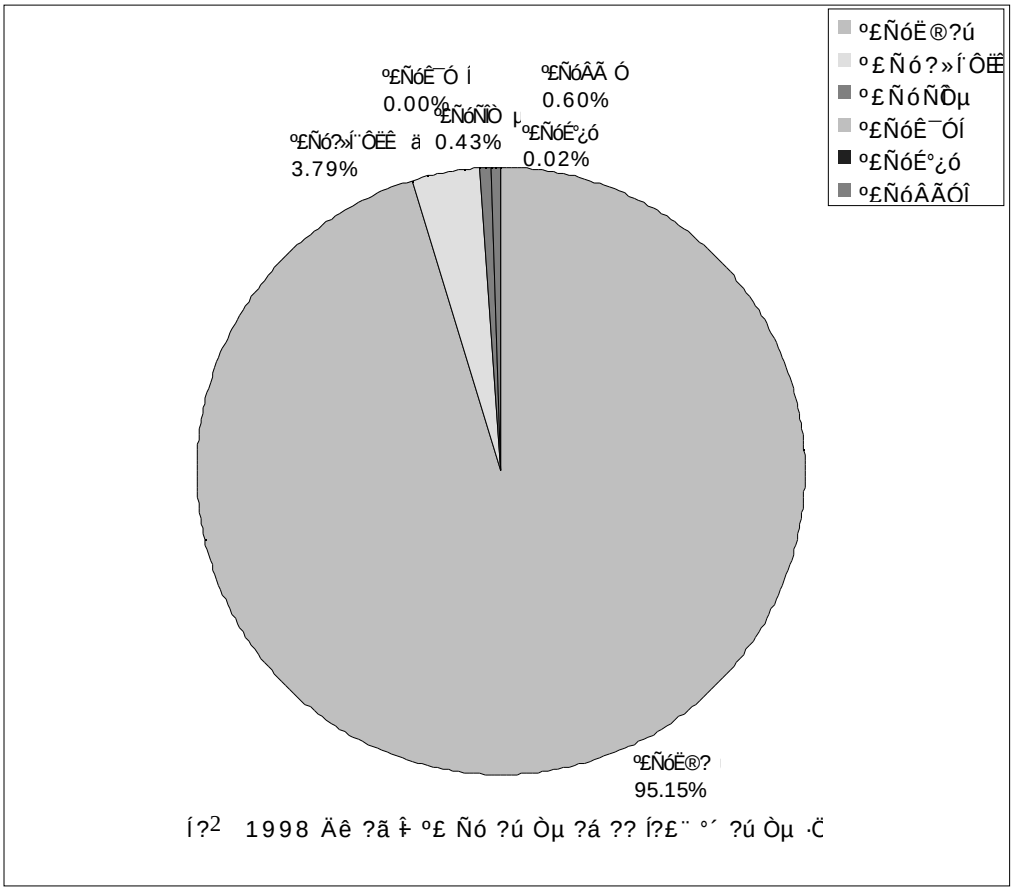
dominancy and is followed by shipping industry. The second industry is dominated by light industry, which is composed of small enterprises with weak base. Heavy industry is not developed. There is no industry with dense technology. Production capacity, technical level or all worker production rates is low in general. Because of shortage of energy sources and technological personnel and because of backward science research work and lower national input due to wars, the coastal economy in Guangxi has been restrained.

Table 1 GDP in coastal cities of Guangxi in 1998 Unit_RMB10^8

City	GDP	GDP		
		1st Industry	2nd Industry	3rd Industry
Beihai	60.48	11.01	18.25	31.22
Fangchenggang	41.55	16.75	12.08	12.72
Qinhzou	80.86	34.98	17.50	28.38
Total	182.89	62.74	47.83	72.32

Table2 Major ocean GDP in coastal cities of Guangxi in 1998 Unit_RMB10^8

Marine fisheries	Shipping	Coastal international tourism	Sea salt	Coastal placer	Total
88.31	3.52	0.56	0.40	0.02	92.81



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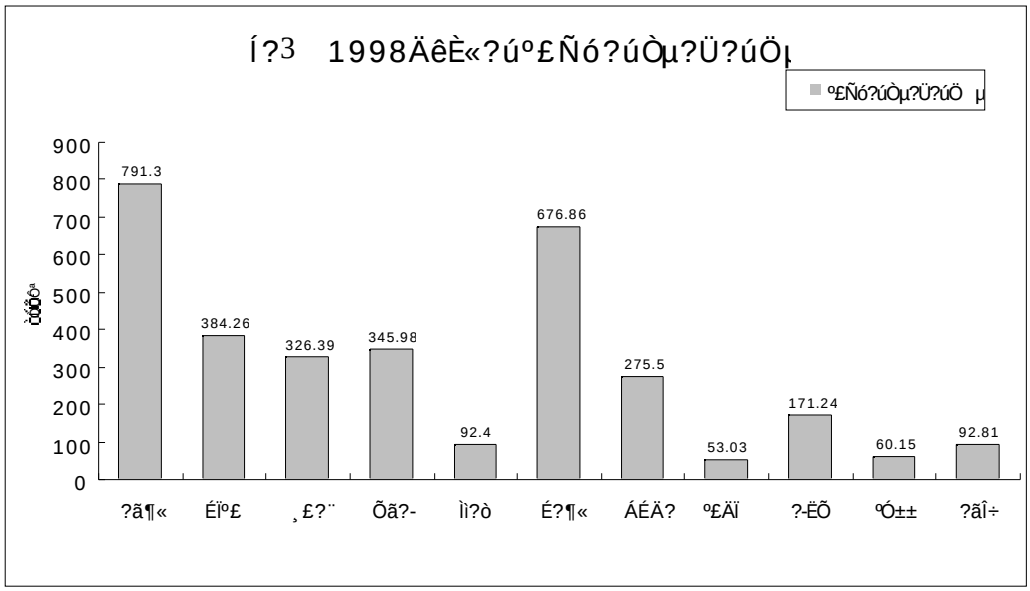


3.Ecoligcal features and ecological conservation bases in the Beibu Gulf

3.1 The Beibu Gulf is a relatively enclosed ecosystem_including strait ecosystem, bay ecosystem, estuarine ecosystem and island ecosystem

The Beibu Gulf is a semi-enclosed bay with flat bottom sloping from the northwest to the southeast_mostly with a slope of 00° 00’30”. The Gulf is within 60 m deep and 38 m deep in average except that at the mouth where water is about 100 m deep. The Gulf covers a total area of 129 000 km^2. The Gulf connects to the open sea by the Qiongzhou Strait and its mouth. Along coastal Guangxi, there are 651 islands and islets each with an area of more than 500 m^2.

The coastal landscape is composed of three types of coast, namely bedrock coast, accumulative coast and biological coast. Among them, the bedrock coast accounts for the most popular us. The steep and zigzag coast has created numerous natural bays and harbors. In Guangxi, there are 8 bays with an area of over 10km^2, all with deepwater coastline. The biological coast, which is composed of mangrove and reef-building coast, is a unique type of coast distributing in the tropical and subtropical waters. The Beibu Gulf receives from Mainland China the runoffs from the Nanliujiang River, Qinjiang River, Beilunhe River and Changjiang River, thus having the estuarine bays and estuarine ecosystem.

3.2 The Beibu Gulf fishing ground is one of the ten largest fishing ground in coastal China. The fishing ground is relatively better protected and the fishery resources are relatively restored

The Beibu Gulf Fishing Ground is distributed in an area of 164 000km^2. The composition is fishery species is similar to that in the fishing grounds in the northern part of the South China Sea. There are 30 species of large kelps, more than 200 species of shellfishes, over 20 species of cephapods, over 100 species of crustaceans and 238 species of fishes. In terms of fish species, the number of species has decreased from 487 species, which was recorded during the Sino-Viet Nam Joint Survey carried out at the beginning of 1960s. At present, the major commercial species under development and utilization include 2 species of large kelp, 10 species of shellfishes, 7 species of cephapods, 9 species of crustaceans and 37 species of fishes. With abundant species of feed organisms, the gulf has a complicated foodweb structure as a species of feed organism may be fed on by many species commercial

fishes and a species of commercial fish may feed on many species of feed organisms. The trophic level of fishery communities is 2.5-3.5. The overfishing in the past has resulted in the destruction of fishery resources in the Beibu Gulf Fishing Ground. The practice of fishing-close in summer and “zero fishery catch growth” since 1999 has brought to some extent the restoration of fishery resources in the fishing ground.

3.3 The Beibu Gulf is distributed with coral reefs, dugong dugong, pearl and great extents of mangroves

Guangxi, Hainan and Guangdong are the major distribution area of mangroves in coastal Mainland China as the total accounts for over 97% (Table 3).

Table 3 Mangroves in Guangxi, Hainan and Guangdong

	Area of mangroves (ha)	
		Mangroves around the Beibu Gulf
Guangxi	5654	5654
Hainan	4836	1000
Guangdong	3813	714
Mainland China	14853	7368

Guangxi used to have 12,246ha and has now only 5,654ha of mangroves_distributing in 7.6% of the coastal beaches. There are 14 species of mangroves in 14 genera and 10 families. In addition, there are 32 species plants growing in the mangrove communities. Of the mangrove species, *Rhizophora stylosa*, *Bruguiera gymnorrhiza* and *Lumnitzera racemosa* are endangered species in China _Four pictures of mangroves_.

The Beibu Gulf is distributed with coral reefs, mainly in coastal Hainan. However, the coral reefs distributing around Weizhou Island and Xieyang Island are of special characteristics. The most species along coastal Guangxi are distributed around the Weizhou Island. The reef-builder corals around both Weizhou island and Xieyang Island are distributed in waters of less than 3.5~10.5 deep. There are 45

species in 21 genera (18 photos of reef-builder corals). The major species are in the genera of *Acropora_Favia* and *Goniastrea.* The distribution area waits for further survey. Table 4 shows the number of coral species distributing in northern South China Sea.

Table 4 Corals in Guangxi, Hainan and Guangdong

	Number of Coral Species		Notes
		Reef-builder corals	
Guangxi	30	20	Most species are distributed around the Weizhou Island
Hainan	150	115	Higher number in the eastern than in the western coast
Guangdong	60	30	Very few species around the Beibu Gulf
China	400	200	

There is Dugong dugong living in the Beibu Gulf, mostly in the waters around Shatian of Hepu County, as there are two favorite species of algae of the mammal. The Chinese Government has designed a nature reserve of dugong there and carried out conservation work_Ten photos_. According to local residents and Xinhua News Agency, Dugong dugong are moving in schools in the waters of nature reserve since 2000.

Table 5 A record of Dugong dugong seen in the past years

Time	Location	Number	Weight_kg_	State	Witness	Recorder
14, Jan, 1978	No. 5 lighthouse	4		Moving in surface water		Fu Naizai
Sep, 1981	Shuzongshan, Nankang	1	600	Killed by dynamite		Fu Naizai
Jan, 1982	Shatian waters	1	N.C	Stranded		Fu Naizai
Dec. 1983	Shatian waters	3	N.C	Stranded		Fu Naizai
1984.2.11	Toushagou, Shatian	1	350	Killed by		Fu Naizai

				dynamite		
5May, 1984	East of Wuni	1	700	Killed by danamite		Fu Naizai
7, Mar. 1984	Rongshugen, Shatian	1	400	Killed by dynamite		Fu Naizai
17, Mar. 1985	Dafengjiang Estuary	1	550	Killed by dynamite		Fu Naizai
5, Apr. 1985	Bailong waters	1	650	Killed by dynamite		Fu Naizai
1986.4.30	Erdonggou, Shatian	1		Moving in surface water		Fu Naizai
6, May, 1986	Xialiangwei, Dianzhou Shoal	1		Moving in surface water		Fu Naizai
7, May,	Pingshakou, Shatian	1		Moving in surface water		Fu Naizai
9, May, 1986	Pingshakou, Shatian	1		Moving in surface water		Fu Naizai
14, Jul. 1986	Xishawei, Shatian	N.C		Moving in surface water		Fu Naizai
15, Dec. 1986	Dianzhou Shoal	1		Moving in surface water		Fu Naizai
7, Apr. 1987	No. 5 lighthouse	1		Moving in surface water		Fu Naizai
7, Apr. 1987	Gaosha sandbar	4		Moving in surface water		Fu Naizai
8, Apr. 1987	Gaosha sandbar	5		Moving in surface water		Fu Naizai
4, Feb. 1988	No. 5 lighthouse	1	176	Killed by dynamite		Fu Naizai
15, Nov. 1991	Chuangjiang waters	1	1800	Killed by dynamite		Fu Naizai
24, Sep. 1991	East of Gaosha Sandbar	1		Moving in surface water		Fu Naizai

1993	Shatian waters	N.C.		Moving in surface water		Su Yongsan
Mid, Apr. 1993	Sandbar in middle Shatian	2		Moving surface water		Fu Naizai
8, Apr. 1993	Daniudong	8		Moving in surface water		Zhang Jianwei
Mid. May 1993	Northeast No.5 Lighthouse	1		Moving in surface water		Su Yongsan
20, May 1993	Around No. 5 Lighthouse	1		Moving in surface water		Zhang Jianwei
2, Jul. 1993	Banbiancao of Dianzhou Shoal	1	140	Killed by dynamite		Fu Naizai
Apr. 1994	Southwest of Dianzhou Shoal	1		Moving in surface water		Su Yongsan
May 1994	Leigongsha of Yingluo Bay	3_4		Moving in surface water		Li Guangzhao
18, May 1994	Shawei of Dianzhou	2		Moving in surface water		Li Guangzhao
Apr. 2000	Lighthouse No. 5, Shatian	1	N.C	Moving in surface water		Fu Naizai
30, May 2000	Yingluo Mangrove Reserve	6	N.C	Moving in surface water	Pang Peng	Li Yuanqiang
5, Jun 2000	Nanwan Bay	1	150	Stranded dead	Fu Zangfen	Li Yuanqiang

Note: N.C.=Not Clear.

The coastal waters along Guangxi is well known for the production of Nanzhu pearl in China and the cradle of pearl culture. The coastal environment is very suitable for the growth and reproduction of pearl mother of shell (Two photos).

3.4 Some marine nature reserves have been established

China attaches great importance to environmental protection. The coastal provinces along northern South China Sea have been implementing carefully national policies of environmental protection. They have not only reduced the disposal of land-

based pollutants to the Beibu Gulf but also esbalished a group of marine nature reserves and marine special protected areas in the Beibu Gulf for strenthening marine ecological conservation (Table 6). In addition, Guangxi has established Guangxi Mangrove Research Center, a unique and special unit for mangrove researches in China. The Center has carried out studies in reproduction, culture and fast restoration of mangroves and aquaculture in mangrove swamps in the past years. Some of the science results of the Center are of advanced level in China or in the world.

Table 6 List of marine nature reserves and special protection areas along the Beibu Gulf **Unit_ha**

Name of Reserve	Level	Established in	Size
Shankou Mangrove Ecology Nature Reserve, Guangxi	State	1990	8000
Beilun Estuarine Marine Nature Reserve, Guangxi,	State	1990	3000
Shatian Dugong Nature Reserve, Guangxi	State	1992	35000
Qinzhou Bay Marine Special Reserve, Guangxi	Province	1992	20000
Sanya Coral Reef Nature Reserve	State	1990	8500
Zhanjiang Mangrove Nature Reserve, Guangdong	State	1991	N.C.
Xuwen Coral Reef Nature Reserve, Guangdong	Province	2000	N.C.
Caiqiao Mangrove Nature Reserve, Hainan	County	1986	N.C.
Xinying Mangrove Nature Reserve, Hainan	County	1993	N.C.

Dongchang Mangrove Nature Reserve, Hainan	County	1992	N.C.
Xialan Mangrove Nature Reserve, Hainan	County	1992	N.C.
Huachang Bay Mangrove Nature Reserve, Hainan	County	1995	N.C.

3.4.1 State-level Shankou Mangrove Ecology Nature Reserve

It is situated in the eastern and western coasts of the Shatian Peninsula that is at the southeast of Hepu County, Guangxi Zhuang Autonomous Region, namely the eastern coast of the Yingluo Harbor, Dandou Sea and Tieshan Harbor. The Nature Reserve has a rather large distribution of mangroves with rather typical and complete structure of natural mangroves along the mainland coast in Guangxi or rather in China. The patch of *R.stylosa* forest in the Yingluo Harbor is rare in China. The Nature Reserve was established in 1990 upon the approval by the State Council for the conservation of mangrove ecosystem distributing in a total area of 8 000 ha (109°37′00″_109°47′00″E_21°28′22″_21°37′00″ N), including land and sea. The core zone has an area of 800ha_the buffer zone 3200ha and the transit zone 4000ha. The State Oceanic Administration is the national agency in charge of the Nature Reserve. The Ocean Development and Management Office of the Guangxi Zhuang Autonomous Region is empowered by the State Oceanic Administration for its operational management and the People's Government of Hepu County is responsible for its administrative management.

When the Nature Reserve was established upon approval, the people's governments and departments concerned at all levels have input man and material resources in large quantities for the planning and development of the Nature Reserve. The Nature Reserve has now greatly improved its infrastructure. In addition to power supply, water supply, communications and bus line, there has built inside the mangrove swamp a 120 m wooden bridge. Two stations have been set up, one in

Yingluo and the other in Yong'an, both with office buildings. In 1997, a science builder and a specimen room were set up. The specimen room now has 32 specimens of mangrove plants, 120 specimens of benthos, 53 specimens of birds and 130 specimens of insects co-living in mangrove forests.

3.4.2 Hepu State-level Dugong Dugong Nature Reserve

It is distributed in the coast waters of 43 km long extending from the Yingluo Harbor in the east to Shatian Town in the west in Hepu County of Guangxi. The Nature Reserve covers an area of 350 km^2_of which, the core zone is 132 km^2_the buffer zone 110 km^2 and the experimental zone 108 km^2 (Map attached). The Management agency of the Nature Reserve is the Hepu State-level Dugong Dugong Nature Reserve, which is co-officed with Guangxi Ocean Environment Monitoring Center. The Nature Reserve is under the leadership of the Environmental Protection Bureau of Guangxi Zhuang Autonomous Region. The management agency has 44 personnel, 31 of science staff of over engineer level . They are distributing in General Affairs Office, Resource Conservation Lab and Shatian Sub-Station. The management agency occupies a land area of 16000 m^2_where a experimental and monitoring builder of 3400 m^2 is built. The builder is equipped with various instruments such as AAS, ionic chromatography, and GC and UV spectrometer.

4_The political atmosphere is supportive of the implementation of the project

4.1 Guangxi is the unique region by the coast in the Western China Development

The Development of Western China is a measure for common wealth of the eastern and middle and western China, as well as a strategic step to realize modernization great state strategy and an important state strategy. As the unique province-level region bordering the sea, Guangxi is situated at the conjunction among the eastern, middle and western regions of China, the conjunction between the South China Economic Cycle , the Southwestern Economic Cycle, the conjunction between the Hong Kong and Macao Economic Cycle and the Mainland Economic Cycle and

the conjunction between the domestic and international markets. As a result, Guangxi has many favorable conditions to implement the strategic development of Western China as it is a great chance for the social and economic development of Guangxi.

4.2 Guangxi acts as the great sea-path of Southwestern China

In 1992_the Central Government instructed Guangxi to play the role of the sea-path for Southwestern China. Then on, Guangxi has been giving all out in its infrastructure capacity building and has built up a three-dimensional, open and easy-access communication network composed by railways, high-grade highways, ports and airports. In the implementation of the strategy of Western Development , Guangxi Government has decided to do a good job in five aspects, namely water, ways, ecology, industrial structure adjustment and science, education and talents. Of which , the aspect of ways refers mainly to further perfect the sea-path of Southwestern China and make it an easy access to the neighboring provinces by further builder up the way network within Guangxi and the ports in Qinzhou, Fangchenggang and Beihai cities. According to the policy, Guangxi will further develop its communication infrastructure, so to give full play of its superiority in coastal location and play a greater role as the sea-path for the Southwestern China.

4.3 Both the central and local governments have accomplished the structure reform

In 1998_the Central Government has accomplished its structure reform and in 2000 the local governments along the Beibu Gulf have accomplished their structure reform. In the course of structure reform, by taking into consideration of the needs in opening to the outside world and reform, each functional agency has adjusted its responsibilities and each comprehensive agency has strengthened its functions. Therefore, the government may manage the economic activities in an n indirect form and make better managements in accordance with laws and regulations. After structure reform, the governmental responsibilities are more reasonable and more suitable to the needs in market economy and management of modern enterprises, and so with better efficiency.

4.4 China attaches great importance to economic development and environmental protection in Guangxi

The Chinese Government attaches great importance to economic development in coastal Guangxi. In 1984, the Central Government made Beihai (including Fangchenggang Port) as one the coastal cities opened to the outside world. Later, Fangchenggang Port was designated as the sea-path of the Southwestern China. More recently, Guangxi has been included in the region for Western Development. At the same time, environmental protection has been strengthened. The first is to implement well the Marine Environmental Protection Law of PRC. The second is to implement the Master Plan for Ecological Capacity Building in Guangxi Zhuang Autonomous Region that has just been developed. The third is to make ecological conservation as an important part for Western Development in Guangxi, in which, many measures have been taken to conserve and restore marine ecological environments.

5. The Legal Basis for the Project

5.1 China has a set of comparatively perfect marine environmental protection laws and regulations

For better ocean management, China has developed many laws and regulations relevant to the management of marine environment, marine resource and shipping and some basic ocean laws. According to a preliminary statistics, China has made public 29 major coastal and ocean laws and regulations, of which , the most important one is the Marine Environmental Protection Law of PRC.

The Marine Environmental Protection Law was first enacted in 1983. In 1999, it was revised in term of practical situations in China and approved by the National People's Congress. The revised Marine Environmental Protection Law stresses sustainable development and extends the scope of marine environmental protection from purely pollution control to that including pollution prevention and marine ecological conservation. More over, the revised Law sets higher and stricter demands on governments and agencies at all level for their responsibilities in marine environmental protection. A new chapter of "marine ecological conservation" has

been added to the law. The chapter makes clear regulations on marine ecological conservation, calling upon the governments above county level to take effective measures to protect marine ecosystems of wetlands, coral reefs and mangroves, to pay abide by natural laws and follow marine functional zonation scheme in ocean development and utilization.

5.2 Sea Area Use Law of PRC in under way of development

For strengthening integrated management of sea area, guaranteeing the rational utilization and development of sea area and increasing the integral social , economic and ecological benefits, the State Oceanic Administration and the Ministry of Finance have accomplished the drafting of the Sea Area Use Law of PRC. The Law is drafted based on the past 6 years of sea area use management and the development reform. The drafted law has been submitted for examination and will be reviewed by the National People' Congress in 2000.

5.3 Large Scale Marine Functional Zonation Scheme Is Promoted in China

Marine functional zonation scheme designates the zone with specific dominant function that is beneficial to the rational utilization and development of marine resources and is capable to bring about optimum benefits. The zones are designated in accordance with the conditions of natural resources, environmental state and geographical location of various zones and by taking into account the state of ocean development and utilization and socioeconomic development demands.

In 1990_under the sponsorship of the State Oceanic Administration, the coastal provinces , autonomous regions and municipalities accomplished the formulation of 1: 200 000 marine functional zonation scheme. Based on this, the formulation of a functional zonation scheme of 1: 50 000 was started in 1999 and will be accomplished in 2000. In specific areas, a scale of 1: 25 000 or oven of 1: 5000 will be developed.

5.4 Coast and ocean are key areas in the National Master Plan for Ecological Construction, which is just under development

For promoting ecological conservation, China is developing National Master Plan for Ecological Construction . The national master plan is based on the local master plans. Guangxi has accomplished at the end of 1999 the Guangxi Master Plan for Ecological Construction, in which, coast and ocean is planned as a specific area . Guangxi Master Plan for Ocean Ecological Construction extends from 1999 to 2050_of which, the short-term from 1999 to 2010, mid term from 2011 to 2030 and long term from 2031 to 2050. Based on the state of art of marine ecological environment and marine ecological construction in Guangxi, the Master Plan analyses the existing issues in marine ecological conservation and predicts the development tendency in ecological construction in accordance with the prediction of coastal social and economic development. The Master Plan proposes the guiding principles and objective in ecological construction, programs, key areas and key projects for ecological construction. In addition, investments for each key project are calculated and the benefits from the projects analyzed. Moreover, measures to guarantee the smooth progress of the ecological construction are proposed.

5.5 Local legal system in Guangxi

The People's Government of Guangxi Zhuang Autonomous Region has developed many local laws and regulations for environmental protection and ecological conservation. Based on practical needs, Guangxi has developed by following state laws relevant to coast and ocean, 19 regulations and rules. In the 19 regulations and rules, 4 are relevant with fisheries, 5 with shipping, 5 with marine resources conservation and environmental protection , 1 with sea area management and one each with hydrolic engineering project and sea salt production(Table 7). The 19 regulations rules may be classified into two types based on its management objectives, integrated ocean management regulations and rules and industrial management regulations and rules.

The availability of these regulations and rules have provided standards and basis

for the management of ocean development and utilization in Guangxi and are playing due role in adjusting ocean development and utilization order, rational distribution of marine resources and promoting sustainable ocean economy development. Among the regulations, the Rules Concerning Sea Area Use Management in Guangxi Zhuang Autonomous Region makes an important breakthrough in ideal sense by regarding the sea as blue land and is beneficial for integral planning and scientific management of sea areas.

6_Public Support

6.1 The state policy of sustainable development is well understood and has won support from the public

China makes sustainable development its basic national policy and Guangxi Government has made great efforts in implementing the national policy. Guangxi Government knows well that it is important to win the understanding and support from the public if the sustainable development policy is to be well implemented. In the public awareness campaigns, the public in Guangxi understands well the necessity and importance of implementing the sustainable development strategy. Now, once there is a case to destroy ecological environments, the local people will report to the authorities concerned.

Table 7 Regulations and rules relevant to coast and ocean management in Guangxi Zhuang Autonomous Region

No.	Name of regulation or rule	Authority
1	Provisional Rule for Implementing the Regulations Concerning the Protection of Marine Fishery Resources of Guangxi Zhuang AR	Guangxi Zhuang AR People's Government
2	Report on the Reform of Methods to Collect Foundation for Fishery Port Construction	The Department of Agriculture, Husbandry and Fisheries and the Department of Finance of Guangxi Zhuang AR's Peoples Government
3	Provisions Concerning the	People's Congress of Guangxi

	Management of Water Conservancy Engineering Projects	Zhuang AR
4	Implementation Rules of Land Management	People's Congress of Guangxi Zhuang AR
5	Implementation Rules of Water Way Management	Guangxi Zhuang AR People's Government
6	Provisional Rules of Environmental Protection	People's Congress of Guangxi Zhuang AR
7	Provisional Rules of Fishery Administration	People's Congress of Guangxi Zhuang AR
8	Methods for Registering Small Boats in Coastal Waters	Guangxi Zhuang AR People's Government
9	Provisional Rules for Collecting Funds for Transport Infrastructure Construction (Part of Shipping)	Guangxi Zhuang AR People's Government
10	Rules for Application and Examination and Approval of New State-level Nature Reserve	Guangxi Zhuang AR People's Government
11	Rules Concerning the Management of Navigational Channels	Guangxi Zhuang AR People's Government
12	Rules Concerning the Management of Beilun Estuarine Marine Nature Reserve	Guangxi Zhuang AR People's Government
13	Rules Concerning the Management of Shankou Mangroves Nature Reserve	Guangxi Zhuang AR People's Government
14	Regulations Concerning the Conservation of Aquatic Wildlife	People's Congress of Guangxi Zhuang AR
15	Rules Concerning the Management of Aquaculture Stocks and Seedlings	Guangxi Zhuang AR People's Government
16	Rules Concerning the Management of Transports Boats in Towns and Villages	Guangxi Zhuang AR People's Government
17	Regulations Concerning the Management of Mapping	People's Congress of Guangxi Zhuang AR
18	A Circular Letter to Strengthen the Management of Salt Industry	Guangxi Zhuang AR People's Government
19	Rules Concerning the Management of	Guangxi Zhuang AR People's

	Sea Area Use	Government

6.2 The sense of state-ownership of sea area and pay to use sea area has been established in general

After many years of sea area use management and publicity campaigns, the public has come to understand that the sea area is of state ownership and the sea is a part of national land. For use of sea area, one has to apply for approval and to pay sea area use fee. Since 1994, Guangxi has examined and issued more than 1600 copies of sea area use permits for the use of 4000 ha of sea area. In the Fangcheng District of Fangchenggang City, the farmers of mother-of-pearl-shell line up to apply for sea area use permit and pay in sea area use fee. Both Hainan and Guangdong provinces are implementing the sea area use management rules from which, certain good results have been achieved. By implementing the sea area use rules, the ocean development activities along the Beibu Gulf are in good order.

6.3 Public participation in integrated coast and ocean management

Integrated coast and ocean management is firstly a governmental action, including the formulation and implementation of zoning , planning, policy and laws and regulations. Integrated coast and ocean management is public action, in which the public is to be managed on one hand and participates in the management practices on the other hand. Guangxi government has attached great attention to the participation and promotion of integrated management practices, such as the drafting of and airing comments on planning, zoning , policies and laws and regulations. The government responds to the report from the public against marine ecological damager cases and gives encourages and support the public.

One of the good examples of Guangxi public participation in the marine ecological conservation is the transplanting of mangroves of the primary pupils of Jiangshan Town of Fangchenggang City. Since 1993, the pupils participated in mangrove transplanting every year and have planted 200 ha of mangrove trees.

7_Recommendation of Specific Projects

7.1 Conservation of Coral Reef Ecosystem around Weizhou—Xieyang Island in the Beibu Gulf

7.1.1 Profile of the Project Area

The Project is to be implemented in the waters around Weizhou Island and Xieyang Island. The Weizhou Island is situated in the waters 48 km to the southeast of Beihai City (109°05__109°15′E_20°50__21°05′N) . This is the largest island in coastal Guangxi. The Island has a coastline of 26.6km and covers a land area of 24.98 km^2. The Xieyang Island is situated 18 km southeast to the Weizhou island (109°12__109°13_E_20°54__20°55_N). It has coastline of 5.7km and covers a land area of 1.87 km^2_Fig. 5_.

Fig. 5 Location of Weizhou and Xieyang Island

_Weizhou Island coral reef forms the largest community of coral ecosystem in the north most in the Beibu Gulf

The coral reefs fringe the Weizhou Island and form the coral reefs with the largest communities and the greatest number of species in the north most in the Beibu Gulf. In this area with subtropical climate, water temperature, salinity, dissolved oxygen, nutrients, currents m sea state and bottom are all suitable for the growth and reproduction of corals.

_With rich coral reef population resources_Photo at the northwest of Dishuicun of the Weizhou Island _

The Weizhou Island has many species of corals. According to the previous survey, there are 45 species in 21 genera, such as *Psammocora, Acropora, Anacropora, Montipora, Povona, Podabacia, Goniopora, Porites, Turbinaria Galaxea, Favia, Favites, Goniastrea, Cyphastrea, Plesiastrea, Hydnophora,*

Platygyra, Leptastrea, Merulina , Echinophyllia and *Pseudosiderastrea.*

The coral reef landscape is well developed around the Weizhou Island and better in the eastern, northern and southwestern parts of the Island. The reef flat is 250_1030m wide with a half of corals of 200_600m in a water depth of -2_-12.5m (Table 8).

Table 8 Width of various landscape units in the Weizhou Island coral reef

Location	Width of each landscape unit_m_				Reef distribution water depth (m)
	Sand Bar	Sand Beach	Reef Flat	Reef Zone	
North of Houbeitan	440	130	1025	600	2_12.5
Southwest of Dishuicun	100	215	475	215	2_10.5

_Good quality of bottom soil and water, with less pollution

The content of organic matter, copper, lead, zinc, cadmium, total mercury and oils in bottom soil and water in the waters around the Weizhou Island and the Xieyang Island is within the normal range, normally of first category water quality standard. The waters is far away from the mainland, without large river runoff, and therefore not subject to the impact of silt and toxic substances carried into the sea by river runoff. With less industrial wastes discharged, very good quality water and bottom soil, suitable water transparency, water temperature, salinity, dissolved oxygen and nutrients for the growth and reproduction of coral reefs.

_Distinct biodiversity in coral reef ecosystem

According to the previous survey data, the number of species and genera of corals and other biological species in the waters around the Weizhou Island and Xieyang Island are listed in Table 9.

Table 9 Number of species in waters around Weizhou and Xieyang Island

Taxa	Number of species
Phytoplankton	87 species, of which diatoms 81 species, dinophyceae 6species
Zooplankton	90 species, mainly hydromedusa, copepod, chaetognath, tunicate

Intertidal zone organism	109 species, mainly shellfishes and algae
Benthos	279 species, mainly crustaceans, molluscs, polychaets, demersal fishes and echinoderm
Nekton fishes	More than 80 species

_Conservation of coral reef has a good social and community basis

On 23, November 1999, the 47th Session of the Standing Committee of the 11th People's Congress of Beihai City examined and approved the Resolution of the Municipal People's Congress on Strengthening the Conservation Coral Reef Resources Around the Weizhou Island. The island inhabitants have a better understanding of the importance for coral reef conservation and the cases of removing corals have been stopped. It is clear that there is good social and community basis for establishing a coral reef ecosystem nature reserve.

_Both Weizhou Island and Xieyang Island are under the jurisdiction of Beihai City. The Weizhou Island is a town-level island and the Xieyang Island is a village-level island under the jurisdiction of the Weizhou Island. On the Weizhou Island, there are two community committees and 9 village committees. According to the statistics of population in 1995, the Island has a total population of 15,900 and total farmland of 962.67 ha. The total area under jurisdiction is 26.63 km^2_of which the Xieyang Island has a land area of 1.81 km2_. In 1995, the gross industrial and agriculture production was RMB 42.23 million , of which the gross industrial production was RMB 14.01 million, the gross agriculture production was RMB 28. 22million_of which RMB 11.87 million from farming and RMB 16.35 million from fisheries _. The total income from the tertiary industry was RMB 78.08 million. The gross production from the township industries was RMB 116 million and the financial income for the government was RMB 0.515 million.

7.1.2 Major Existing Marine Ecological Issues

There is no systematic baseline data of coral ecosystem(background data). No baseline survey of coral ecosystem has been carried out in the waters around the

Weizhou and Xieyang Island. However, in 1984, Guangxi Institute of Marine Sciences, the Department of Geology of Tongji University and the Institute of Oceanology of the Chinese Academy of Sciences jointly carried out a general survey by diving on the distribution and species of corals in the waters around the Weizhou and Xieyang Island. In 1998, John Wang and his colleagues of Hong Marine Environmental Protection Association, with the assistance of Guangxi Oceanic Administration, Beihai Fishery Administration and Guangxi Institute of Marine Sciences, carried out a survey to identify coral species in the waters to the southwest and northeast of the Weizhou Island and the waters to the northeast of the Xieyang Island. It is imperative to carry out a baseline survey of coral reef ecosystem in the waters around the Weizhou Island and the Xieyang Island.

There still exist some cases of artificial damage of coral resources. In the past few years, some units and individuals were engaged in the harvesting, purchasing, processing and sale of coral crafts in the waters around the Weizhou and Xieyang Island. In addition, coral reefs were used for building materials. These activities have brought about damage to the coral communities and the associated marine ecological environment. It is fortunate that the Beihai People's Government has taken effective measure to stop the activities.

7.1.3 Work Scheme for Coral Ecological Conservation

Objectives of coral ecosystem conservation. Based on the a systemic baseline survey in the waters with coral reef ecosystem around the Weizhou Island and the Xieyang Island, to establish a nature reserve of coral reef around the island. It is intended to promote the capacity of the local government in its planning and management of island resources and promote island ecotourism. It is intended to make use of the geographical superiorities and promote the sustainable development of island economy , so as to win the optimum ecological social and economic benefits. It is intended to make due contribution to the international plans for the

conservation of coral reef ecosystem and marine environment.

Major Actions_

_It is imperative to carry out baseline survey in the waters with coral reef ecosystem;

_Survey of landscape, geomorphology and bottom soil in the waters with coral reef ecosystem;

_Identify the species, genera, quantity, height, distribution density, area, water depth, coverage and community structure of corals;

_Identify the species and genera of fishes, shellfishes and algae and their species composition and quality in the coral reef ecosystem waters;

_Analysis of the regulations of changes of tides, currents, waves, water temperature, salinity, dissolved oxygen and various nutrients in the coral reef ecosystem waters;

_Survey of island-based pollution source that may have potential impact on the coral reef ecosystem;

Establishment of coordination mechanism for integrated management;

Formulation of management methods and measures for the conservation coral reef ecosystem;

Development of ecotourism plans in the island ;

Promotion of publicity and public participation in the conservation;

Personal training;

International cooperation;

7.1.4 Expected Results

_Survey and study report of state of coral reef resources and marine ecological environment

By analysis of the field survey and observation results and record of identification and photos taken in the field and , by processing , statistical analysis and

integrated analysis of determination data, formulate a baseline report of coral reef ecosystem in the waters around the Weizhou Island and Xieyang Island.

_Establishment of Weizhou-Xieyang Island Coral Reef Ecosystem Nature Reserve

For conserving coral reef resources, fishery resources and ecotourism of the islands, and for maintaining marine ecological equilibrium and promoting sustainable development of ocean economy and tourism of the islands, it is planned to establish the Weizhou-Xieyang Island Coral Reef Ecosystem Nature Reserve.

Build up a monitoring and data network of coral reef waters.

7.1.5 Beneficiaries

The public and local governments of the Weizhou Island, the Xieyang Island and Beihai City, the units involved in the protection and management of tourism and marine ecological conservation.

7.1.6 Organization and implementation of the Project

The effective implementation of the project needs the joint efforts of all the units concerned. It is important to turn various forces into an integrated entity for servicing the general objectives by proper organization and coordination. Therefore, it is recommended to set up a special organization and coordination institution.

The organization and coordination institution will be set up in Beihai City and is composed of the management staff of Beihai People’s Government and its agencies and Guangxi Oceanic Administration and the public communities.

7.1.7Budget and timetable of the Project

_Project budget

The total budget for the project is estimated to be USD 1 120 000_of which USD 220 000 should come from the international organizations or other countries, USD 900 000 will come from government budget or domestic donation.

Table 10 Budget for Building up a Coral Reef Nature Reserve around Weizhou

and Xieyang Island **Unit**_thousand USD

Project	Item	Quantity	budget	Source
Baseline survey of coral reef ecosystem	Coral reef resource survey	50km^2	40	Aids from international agencies and other countries
	Survey of intertidal zone organisms, benthos, nektons	150 km^2	60	
	Survey of phytoplankton and zooplanktons	150 km^2	30	
	Survey tools and underwater camera and video recorder	A set	25	
Planning of nature reserve	Zoning of nature reserve	Several zones	25	
	Island resource development and utilization and its sustainable development	Several	40	
Subtotal			220	
Land purchase and capital construction	Land purchased for building the station for the nature reserve	0.4ha	70	Domestic budget and social donation
	Construction of office building, land leveling and infrastructure building, signs of the nature reserve	One set	125	
	Labs	One set	60	
	Dormitory for staffs	One building	60	
Equipment	Facilities of meteorology, hydrology observation and environment monitoring	One set	120	
	Communication car and motorcar	One vehicle each	45	
	Motor-boat	2 vehicles	25	
	Law-enforcement and management boat	1 vehicle	45	
Tourism facilities			300	
Publicity and education faculties			70	
Subtotal			920	
Total			1140	

_ Implementation timetable(four years from January 2001 to December, 2004)

The time is scheduled as follows_

January 2001_December 2001_Identification coral reef species, survey of its quantity, distribution size, height, coverage, density, seabed landscape and bottom soil survey; Survey, analysis ,identification and determination of intertidal organisms, benthos and nektons; Analysis and identification phytoplankton and zooplanktons; Formulation of baseline survey report.

January 2002- December 2002_Apply for setting up Weizhou-Xieyang Island Coral Reef Ecosystem Nature Reserve; Management and conservation planning of the nature reserve and planning of environmental monitoring and eco-education.

7.1.8 Risk Assessment of the Project

_Lower risk in setting up a nature reserve as the candidate area is lower in ocean development

The Weizhou Island is an island formed by accumulation in the process of seabed emission of the Quaternary basalt magma. The development of coral reefs around the island has formed themselves into a coral reef ecosystem with rich biological resources and species. The oil and gas exploration and exploration several kilometers south away from the island and the fishery activities around the island may have potential impact on ecological conservation of the coral reef. However, as the economic activities are at a lower degree, the reefs are in a good state of growth and development. There is few risk in carrying baseline survey and setting up a nature reserve there.

_ Risk analysis of Wei 12—1 Oil Field development and Oil and Gas Terminal

The EIA of Wei 12—1 Oil Field Development was made by China Offshore Oil Engineering and Design Corporation. The EIA has made an overall assessment on the offshore oil platforms, submarine tubing system and land-based processing terminals , formulated strict prevention measures against oil spill and established oil spill

contingency center. The investment for environmental protection facilities and environmental monitoring station was made in accordance with the Design Standard for Petroleum Chemical Enterprises developed by China Petroleum Chemical General Corporation , its environmental protection investment is comparable to that of environmental protection investment and project investment in the world. At the same time, the engineering design for oil and gas development in terms of safety, environmental protection, automatic control, seabed tubing system and fire prevention follows strictly state laws and regulations, norms state standards and the national standards of other countries accepted in the world. Precaution measures are taken to prevent oil spill accidents in the process of production and operation. Based on the above analysis, as the oil terminal has taken strict precautionary measures against environmental impact, there is little risk against the implementation of the Project.

7.2 Capacity Building of Shankou Mangroves Conservation and Ecotourism

7.2.1 Profile of the Project Area

The Project is to be implemented in the Shankou State-Level Mangrove Ecosystem Nature Reserve. Set up in September 1990, the Nature Reserve is situated at the waters between $109^0$37'00"~$109^0$47'00"E and $21^0$28'22"~$21^0$37'00' N. The Nature Reserve in under the administration of the State Oceanic Administration at state level, Guangxi Oceanic Administration at province level. Hepu County of Beihai City is responsible for daily management(Fig. 6).

The Nature Reserve covers an area of 8000ha_of which 4000ha are at sea and 4000ha on land. The Reserve is zoned into three functional zones, namely 800ha of core zone, 3600ha of buffer zone and 3600ha of transient zone (Fig. 7). The core zone is situated at the eastern coast of the Shatian Peninsula, extending from the Ximihe estuary to the beach of Yingluo. The core zone has now 220 ha of mangroves. The buffer zone, with 510 a of mangroves, is composed of the narrow strip of tidal beach at the border between Guangdong and Guangxi and of the whole Dandou Bay at the

western part of the Shatian Peninsula. The transient zone refers to the land area 1 km above the high tide mark from and the peripheral waters outside of the nature reserve. Their major functions are to buffer and limit unfavorable impacts on mangroves and marine environments from land-based and sea-based artificial activities and natural factors.

The previous studies show that the nature reserve has 13 species of mangrove plants. The major community builder species include *Avicennia marina, Aegiceras corniculatum, Rhizophora stylosa, Bruguiera gymnorhiza, Kandelia candel* and *Excoecaria agallocha*_they having formed 6 typical mangroves communities along coastal Guangxi. Different communities are distributed in belts in general parallel to the coastline in the intertidal zone and their growth and development are subject to the conditions of nutrients, bottom soil and salinity. From outer beach_low tide mark_to inner beach(high tide mark)_soil changes from sandy, soil, muddy to semi-harden mud, salinity from high to low and the communities from single dominant community to compound community such as *Avicennia marina*_*Kandelia candel*_*R. stylosa*_and *B. Gymnorrhiza* communities. The compound community of *Avicennia marina* + *Aegiceras corniculatum* is widely distributed on different soils.

There has recorded 179 species of large benthos, 82 species of fishes, 106 species of bird, 97 species of phytoplankton, 26 species of zooplanktons, more than 100 species of benthic diatoms and 258 species of insects in the nature reserve. In addition, there grow in large numbers of *Spartina* sp. and sea grasses in the nature reserve. It is rare in China to a nature reserve consisting of mangroves and higher plants such as *Spartina* sp. and sea grasses.

Most of the inhabitants in Shankou Nature Reserve are Han people, whose forefathers moved here from coastal Fujian. They are scattered in 14 villages along the nature reserve. In the past, especially in the period from the end of 1950s to the middle of 1970s, land use inside the nature reserve was to be turned into saltpan or

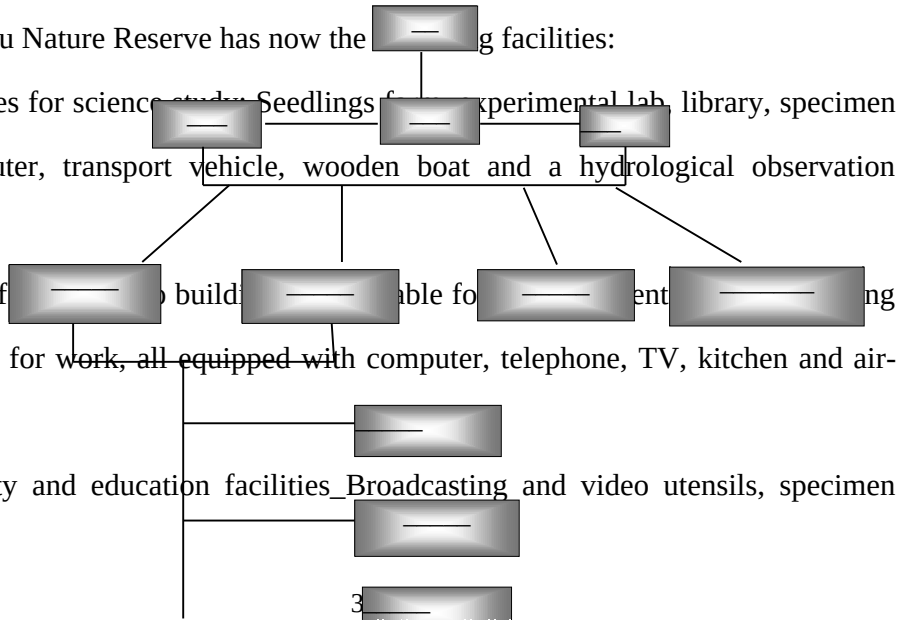
paddy fields. These activities removed a large area of mangrove and have reduced the distribution area of mangroves. No much primary mangrove trees are left as the local inhabitants used to use mangrove tree for firewood. The trees now in the nature reserve are the secondary and dwarf trees. Inside the nature reserve, there live 48 545 people, all in the transient zone. They are engaged mainly in farming of rice or others or culture fowls or cattle and some in mariculture and coastal fishing.

The major artificial activities impacting the nature reserve at present include the turning mangrove swamp into shrimp ponds and harvesting commercial benthic organism under the trees. The harvesting has prevented the restoration of the secondary trees or even caused the decline of coastal fishery resources by way of food chains.

7.2.2 Profile of the Nature Reserve

The Hepu People's Government has established a Nature Reserve Management Division in its institutional framework, which is composed of Sector of General Affairs, Sector of Operation and Sector of Public Security. Under the Division, there are two management stations, one at Yingluo and the other at Dandou. The Nature Reserve has now 11 permanent staff and hires 9 local people as wood watchers. Of the 11 staff, 3 are with higher professional title and 4 with middle professional title, thus forming a management and monitoring network with the Division as the core.

Shankou Nature Reserve has now the following facilities:



Facilities for science study: Seedlings farm, experimental lab, library, specimen room, computer, transport vehicle, wooden boat and a hydrological observation station.

Living facilities: Two buildings available for accommodating and the other for work, all equipped with computer, telephone, TV, kitchen and air-conditioners.

Publicity and education facilities: Broadcasting and video utensils, specimen

display room, meeting room, publicity board, pop science pamphlets and publicity materials, warning board, mangrove-view-stand and wooden-bridge inside the wood.

In the Nature Reserve, the Rules Concerning the Management of Shankou State-Level Mangrove Ecosystem Nature Reserve was enacted on 1, July 1994, the Rules of Nature Reserves of PRC on 1, December, the Rules Concerning the Management of Marine Nature Reserve on 29, May 1995 and the revised Marine Environmental Protection Law of PRC on 1, April 2000.

The Nature Reserve has made various studies and experiments in the past years, such as capacity-building planning, eco-culture experiments and studies on mangrove seedlings, fish population dynamics, and insects in mangroves, mangrove productivity and social economy. The Nature Reserve carries out every year publicity campaigns in various forms and receives a great number of media people and officials from central or local governments, resulting in significant social benefits.

The Nature Reserve has made close operational contact with sister nature reserves in China, such as Beilun Estuarine Marine Nature Reserve of Guangxi, Zhanjiang State-Level Mangrove Nature Reserve of Guangdong, Dongzhai State-Lev el Mangrove Nature Reserve and Qinglan State-Level Mangrove Nature Reserve in Hainan. The Nature Reserve sends staffs to participate in the training course sponsored by Maipo Mangrove Nature Reserve in Hong Kong and intends to set up operational and cooperative relationship with Maipo. In 1997, the Nature Reserve became a sister nature reserve of Rookery Bay National Estuarine Research Reserve in the United States and became a member of MAB Network of UNESCO in January, 2000.

7.2.3 Work Scheme

_Objective1 Conservation of Mangrove Ecological Resources

Rhizophora stylosa forest is a resource of the Nature Reserve with special

significance. Since the establishment of the Nature Reserve, this type of community has been distinctly conserved and restored. In 1991, there was no higher *Rhizophora stylosa* forest in a large area in Dandou and in 1999, a large area of higher *Rhizophora stylosa* forest came into existence_an increase of 10% in area at least than that in 1991.The mangroves at the Ximi Estuary have been severely damaged due to the development of shrimp ponds. Some small-scale damages are also found in other sections. The Management Division of the Nature Reserve stopped some of the damage events in time.

With attention from the government and the public, large scale damage of mangroves have been put under control. However, some people just want to turn mangrove swamps into shrimp ponds for cash income. The new tendency is remove mangroves in small scales like worms and this has increased the difficulties of conservation.

The harvesting of commercial organisms under mangrove trees has profound impact on the productivity and stability of mangrove ecosystem. This kind of damage is indirect and of higher frequency, therefore of greater difficulty for management.

In order to practice absolute protection of mangrove resource with special significance , it is imperative to make clear the sites that need absolute protection and strengthen its conservation.

_Action 1 Restoration of Mangrove Resource

The mangrove forests in Shankou is composed of three types of forests, such as Source Forest of Mangrove, Secondary Forest from Natural Restoration and Secondary Forest due to Degradation(Table 11).

At the estuary, there is an area of 9.25hm^2 of tidal beach without mangrove trees. It is intended to introduce *Sonneratia alba* and *Aegiceras corniculatum* trees to the beach as the two species grow well with lower salinity.

The plan for the restoration and conservation of mangroves is shown in Fig. 9.

Table 11 Plan for Restoration and Afforest ration of Mangroves

Type of mangroves	Forest features	Number on the map	Area (hm^2)	Restoration and utilization plan
Source Forest of Mangrove	Special resource, with higher landscape and ecological value	10,12,13,17	127	Under special conservation. Seedling base. Fill plants in the area without tree
Secondary Forest from Natural Restoration	Compound communities in the process of evolution. Beaches unsuitable for reform.	Numbers. 4,5,6,9,14,15,18 and part of numbers 2, 7, 11, 16, 19	480.45	Maintain or artificial promotion of the natural renewal of mangroves. Filling plants in the area without trees.
Secondary Forest from Degradation	Secondary forest represented by *Avicennia marina* + *Aegiceras corniculatum* community	No. 1, all, part of numbers 2,7,11,16,19	138.8	Afforest ration and forest reform
Tidal Beach suitable for afforest ration	Shallow tidal ditch out of sea dyke	3	9.25	Afforest ration

Analysis of Results_By this action, the mangrove resources in the Nature Reserve will be restored in three years. The area with mangrove trees will increase 10-15% and the ecological environment of mangroves will be greatly improved. This provides a good habitat for animals living inside the Nature Reserve and forms a protective forest belt of 50 km long along the coastline. The protective belt will protect against hurricane and storm surge on one hand and promote fishery development on the other hand, bring benefits to the ecosystems and local people.

_Action 2_Building up Ecological Monitoring System

Ecological monitoring intends to know timely the ecological quality and cause of changes in the Nature Reserve, so to avoid the degradation of ecosystem or to take necessary measures against degradation. Ecological monitoring helps strengthen conservation and management of the Nature Reserve and promotes the friendly cycle of the ecosystem and the wildness of important species.

1_Parameters and factors for ecological monitoring

A. Biodiversity monitoring

B.Ecological environmental monitoring

C. Ecological landscape monitoring

2_Frequency in ecological monitoring

3_Monitoring Methodology

A. Location-set station for ecological monitoring

B. Time-set monitoring

C. Integration of social data and filed survey data and lab analysis results.

D. Dynamic monitoring of mangroves by making use of advanced technology such as remote sensing and GIS.

F. Facilities and fund are needed.

Table 12 Facilities and Fund for the Action Unit: Thousand USD

Facilities and equipment	Use	Fund
2 sets of Model PIII computer	Data processing and multi-media data bank	4
2 sets of Model IBM PII 266 portable computer	Field data input and data terminal	6
Two 25 horsepower motorboat	Sampling and communications	11
Model HACH Drel/2010 portable multi-function water quality analyzer	Nutrient monitoring	9
Model YSI portable DO meter	Physical factors monitoring	8
Automatic meteorological station	Meteorological observations	20
In-lab N,P auto-analyzer	Analysis of detritus nutrients and element fluxes	12
Digital camera	Multi-media and home page	10
Others	Small facilities and materials	10
Total		90

_Action 3 Strengthen education and publicity of mangrove ecosystem conservation and improve public sense of nature conservation

It is important to increase the sense for environmental protection of the public , especially of the local habitants and deal well the relationship among the individual,

collective and state benefits, the relationship between short-term and long-term benefits. it is imperative to encourage them to participate in ecological conservation activities and to launch frequent publicity campaigns in various forms.

It is important to improve education and training of the staff in the Nature Reserve and increase the level of management.

_Action 4 Development of domestic and international training

It is planned to sent two staffs each year to study for a year in Zhongshan University and Oceanic University. Ten staff will be trained according to needs in this way in total.

Short-term training course will be run for the staffs according to needs. Professionals will be invited to the Nature Reserve to carry out trainings. It is intended to run two training courses twice one week and 20 people for each course. 200 people/times will be benefited.

It is planned to send key professional staffs to study abroad. It is intended to train 3 staffs , 3 months each.

_Objective 2_Development of ecotourism

Shankou Nature Reserve is rich with tourism resources. The Yingluo Harbor, where the management station is situated, has a good view of Ma'an Hill landward and wide distribution of mangroves seaside. It displays an excellent view, which is absent in inland area and the coast in the north. The pure forest of *R. stylosa* and communities of *B. Gymnorrhiza* give a rare spectacle in floods and ebbs and with birds flying over the crown and crabs moving along truck.

The Nature Reserve has built a wooden bridge, barrel-floated bridge and bird-view stand inside the mangrove wood at the Yingluo Station. More over, the Nature

Reserve has built a hotel with more than 10 rooms and with the help of Guangxi Mangrove Research Center a Display Room of Specimen.

With the available tourism facilities, ecotourism has been developed in Shankou since 1995. According to statistics, 100 000 people/time has visited and made an income of RMB 120 000. However, if more fund is available to build more tourism facilities and improve advertisement and service quality, more tourists will be attracted.

_Action 1

Pay attention to the close coordination between the management and business operation units and bring management into good order. Increase investment for improving facilities and bring the existing facilities into full use. In the course of investment and construction, advices and recommendations from the specialists should be brought into full consideration for preventing impact on mangroves from tourism pollution. It is important at the first stage of operation to develop advertisement and publicity for attracting both tourists and investors. Improve training to increase the professional quality of the staff and the business operators inside the Nature Reserve.

_Action 2

In the part of hardwires for tourism, in addition to the available boats and display room of samples, it is considered to build a fishing pavilion at the outside fringe of mangrove forest or fishing ponds in the waters inside the sea dyke. In the Ma'an Hill, it is planned to build some wooden huts ,with seafood restaurants, for holiday tourists. It is planned to publish pamphlets and relevant pop science readings about Shankou Nature Reserve for improving the knowledge of the tourists about

mangrove ecosystems. To produce tourism souvenirs with mangrove features such as specimens of mangrove leaves and seeds, T-shirt or caps. In addition, the transport should be improved. A bus line between Shankou Town and Yingluo Station should be open for convenient of the common tourists.

Benefit Analysis_

Table 13 Estimation of flow of tourist and economic income in Shankou Nature Reserve

Year	Tourist (people)	Expense per person(RMB)	Total income (RMB)	Remarks
2000	20000	2	40,000	Food and accommodation not available
2001	25000	5	75,000	Food and accommodation available
2002	30000	10	300,000	Food, shopping and accommodation available
2003	40000	20	800,000	Food, shopping and accommodation available

7.2.4 Implementation unit and work schedule

The Shankou Mangrove Ecosystem Nature Reserve and Guangxi Mangrove Research Center, Guangxi Zhuang Autonomous Region Oceanic Administration and Hepu People's Government undertake the Project. The Project extends from 2001 to 2004.

7.2.5 Budget

Unit : Thousand USD

Item		Budget	Action
Restoration of mangrove resources	Base of mangrove seedlings	25	Build up a base of mangrove seedlings, engaged in studies on quality of mangrove seedlings, reproduction of high quality species and artificial reproduction
	Restoration of mangrove resources	20	Studies on afforest ration and restoration secondary forest and re-habitat
	Mangrove ecosystem monitoring	90	Build up mangrove ecosystem monitoring system , monitoring stations and train monitoring staff
Development of mangrove tourism resources	Planning for development of mangrove ecotourism resources	20	Studies on development of ecotourism and formulation of ecotourism plan
	Mangrove Ecotourism facilities building	15	Improve tourism and service facilities and increase service quality and management capacity
Publicity ,education And training	Formulation and implementation publicity and education campaigns	15	Formulation of publicity materials for conserving mangrove resources, launch of publicity campaigns at various levels to increase the public awareness for conserving mangrove resources
	Personal training	15	Formulation of training plans for conservation, management and research. Implementation of personal training plans for increasing levels in research and management.
	Cooperation and exchange	15	Domestic and international cooperation and exchange
Total		215	

7.2.6 Risk assessment

Ever since the establishment of the Nature Reserve, there has been the conflict between development and conservation. The enthusiasm for ocean development of the local people has been increasing. How to correctly guide the mode of development and deal well with the relationship between development and conservation has been important for the success of the Project. The recommended project intends to build up capacity in ecological management and develop publicity and ecological education and explores the development of ecotourism. It is believed that the project will solve well the conflict between conservation and development in the Nature Reserve. The local governments wish to obtain international aids in funding, technologies and management experiences, so to deal well with the relationship between development and conservation for promoting the sustainable development of local ocean economy.

7.3 Marine Ecological information management and decision-making system in the Beibu Gulf

7.3.1Project area

The Beibu Gulf is situated at the northwestern part of the South China Sea. The Circum-Beibu Gulf includes the southern part of Guangxi Zhuang Autonomous Region, the western part of Hainan Province, the Leizhou Peninsula of Guangdong Province and the northern part of Viet Nam. In the past few years, the economic development in this region has been rather rapidly although the level of development has been low. Therefore, the degree of pollution is not high and its environmental quality of the best in China. The project area is recommended to be in the coastal waters of Mainland China.

7.3.2 Work plan

_Objectives

The overall objectives are to build up a information system with complete

structure covering mangroves, coral reefs and sea grass in the circum-Gulf area. The System collects and stores data of mangroves, coral reefs and sea grass. By analysis of the data collected under the support of the computer system, new decision-making information will be produced for scientific management of mangroves, coral reefs and sea grass in the project area.

_ Major actions

_Software and hardwires

_GIS training courses to train personnel for servicing, managing and using GIS

._

_system design

_Input into the system in accordance with points, lines and faces of data of coral reefs, mangroves and sea grass in the project area to form a basic GIS data bank. Then turn the basic GIS data into complete digital maps, which will be assigned with property information and map information to develop into GIS information for further renewal and extension.

_Interface optimization and secondary design

_Test and perfection of the system

_Verification and put into use

7.3.4 Key technologies to be tackled

_Profile data collection of coral reefs, mangroves and sea grass in the project area.

_Development of GIS application system of mangroves, coral reefs and sea grass in the project area.

7.3.5 Expected results

_Development of a GIS system to indicate the information of mangroves, coral reefs and sea grass in the project area. The system shall suits well the actual needs in the management of mangroves, coral reefs and sea grass in the project area and

reflects well the history and state of art of mangroves, coral reefs and sea grass in the project area. The system is powerful and solid in function with easy operational interface

_A technical summery and a work summery of the project.

7.3.6 Beneficiaries

The beneficiaries of the project include _1). The provincial ocean administration agencies of Guangxi and Hainan_2). The local governments in the project area of Guangxi, Hainan and Guangdong; 3). The local inhabitants. 4). The people and governments receive beneficial from the healthy ecosystems in the Beibu Gulf.

7.3.7 Organization and implementation of the project

_Undertaken unit

Guangxi Zhuang Autonomous Oceanic Administration

Hainan Provincial Oceanic and Fisheries Bureau

National Marine Data and Information Center

- Work Schedule

Table 14 Work schedule for marine information system building

Contents	Time
Collection of profile information about mangroves, coral reefs and sea grass along the Beibu Gulf in Guangxi, Hainan and Guangdong	4 months
Determination of the management objective of the system and the capacity of the data bank	2months
Soft and hard wares of the system	2months
Build up GIS basic data bank and GIS system for coral reefs, mangroves and sea grass along the Beibu Gulf in Guangxi, Hainan and Guangdong	6months

Trial operation and formulation of regulations and administration of the operation of the system	4months

7.3.8 Budget

Table 15 Budget for marine information system building in Beibu Gulf

Unit_Thousand USD

Item	Budget	Actions
Purchase of instrument and equipment	45	Hard wares and software of the system
Training fee	25	Personal Training for use and service of GI, including one international training and 2 domestic training, for 6-people/ time in total.
Fees for experiments and cooperation	45	Cooperation fee building up the system
Costs for consultation and cooperation with international and domestic consultants	25	Including costs for international and domestic travels
Costs for printing data	4	Typewriting and other expenditures
Costs for surveys and travels	30	Survey, collection and purchase of data for the development of environmental profile and the travel cost therein.
Costs for examination and acceptance of the system	14	Expenditure for meetings
Other expenditures	12	Costs for maintenance of the system

Total	200	

7.3.9 Risks

In the marine ecological conservation work in the past years, either Guangxi, Hainan or Guangdong have collected some basic data concerning mangroves, coral reefs and sea grass. National Marine Data and Information Center is rich in experiences in the development of GIS system. It is believed that the project has a strong and solid base. However, the following risks have been identified:

1) The delay of field survey for profile data due to climatic factors may delay the process of the whole project.

2). The incomplete collection and survey of profile data will result in the incomplete information reflected in the GIS system.

3) The incomplete collection of historical data of mangroves , coral reefs and sea grass will result in the incomplete historical data in the GIS system.

7.4 Conservation and restoration of mother of pearl shell

7.4.1Profile of the project area

Mother of pearl shell (Pinctada.martensii (Dunker)) is the major shell that produces over 95% of sea pearl in the world. The shell is mainly distributed in the waters in Guangxi, Guangdong and Hainan, Taiwan in China and coastal waters of Japan, the Philippines and Vietnam. Although it is distributed in a wide range, the Beibu Gulf has been its major distribution center. Coastal Guangxi is the hometown of mother of pearl shell and the most important base for sea pearl production, ever in the history. The shell is distributed in an area of 112 km^2 in the Beibu Gulf (Fig. 10).

The project is recommended to be implemented in the waters of Yingpan of Beihai City in Guangxi.

7.4.2Major Issues in the development and conservation of mother of pearl shell

_More serious environmental pollution has impact on the development of pearl production;

_Coastal Ecological damage has impact on the survival and aquaculture of mother of pearl shell;

_Out-of-order and over use of resources has resulted in the rapid decrease of natural stock and declining the ability of self-evolution and succession of the natural population.

_Intimate reproduction has resulted in the serious degradation of stock quality .

_Out-of-order and out-of-dimension development of pearl culture industry.

7.4.3 Work plan

_Objectives

The overall objectives of the project are to restore and protect the stock resources of mother of pearl shell in the project area and to develop operational mechanism and means to monitor and control marine environmental quality. It is intended to maintain the ecological equilibrium and biodiversity in the project area and to promote the sustainable utilization of mother of pearl shell resources and sustainable economic development in the project area.

_It is intended to restore to a certain extent the quality and quantity of natural population of mother of pearl shell in the project area and set up proper operational measure and mechanism for stock conservation.

_Set up mechanism for sustainable marine resource development and utilization and environmental protection.

_Set up effective network for prevention and control of marine pollution and build up the capacity to prevent and control marine pollution.

_Restore gradually the mangrove ecosystems around eh traditional reproduction waters of mother of pearl shell and maintain biodiversity in the waters for the sustainable development of pearl culture industry and the health of local ecological environment.

_Actions

_Set up protection area for natural stock of mother of pearl shell for protecting

the succession of the natural stock. By survey and studies, set up a protected area of 10 000 ha of for protecting natural stock of mother of pearl shell in the waters of Yingpan in Tieshan Harbor of Beihai City. Strict measures will be taken to protect the stock. On site monitoring and protection units will be created.

_Develop technologies for fast reproduction and nursery of mother of pearl shell. Strict control the source of spawning shells for artificial reproduction and avoid the intimate reproduction. Produce high quality spats for the development of pearl industry.

_Develop basic survey and studies on the water suitable for the development of aquaculture of mother of pearl shells. Identify the capacity for aquaculture based on scientific findings. Develop the plan for the development of pearl culture industry and control the scale of development.

_Set up a network for environmental monitoring and set total pollution load control on key aquaculture waters and its surroundings. Develop pollution control plan and set up the indexes for controlling total pollution load.

_Carry out ecological control program in the coastal waters and formulate plans to plant and restore mangrove ecosystems in the coastal swamps.

_Develop technical support system and technical training system. Carry out educational and publicity work to increase the sense of the public for resource conservation and ecological equilibrium.

_Expected results

_The degradation of stock quality of mother of pearl shell in the project area is controlled and the natural stock will recover its capacity of self-reproduction.

_The development and utilization of mother of pearl shell come into healthy cycle.

_ Set up effective network to prevent and control marine pollution and avoid the damages caused by environmental pollution.

_ Conservation of regional biodiversity;

7.4.4 Beneficiaries

There are about 15 000 people in coastal Guangxi now engaged in the aquaculture and processing of pearl and the number of people engaged in the relevant operations will be 5000, from which an annual production of RMB 350 million is reached . The implementation the project wills being better economic benefits for them. The increase both in quality and quantity of pearl and the reduction of aquaculture risks produces higher than 20% of economic benefits (i.e. RMB 350 million x 20% = RMB 70 million). At the same time_the effective control and monitoring of regional pollution will greatly improve regional environmental quality and promote the sustainable development of other ocean economic activities.

7.4.5 Implementation

For a smooth implementation of the project, a steering and implementation institution of the project should be established. The institution is recommended to be set up in Beihai City and composed of Beihai People's Government and its relevant agencies, Guangxi Zhuang Autonomous Region Bureau of Fisheries, Bureau of Environmental Protection and others.

7.4.6 Budget and work schedule

_Budget

This project needs about USD 200 000 (Table 16).

Table 16 Budget for the conservation and restoration of mother of pearl shell resources Unit_thousand USD

No.	Contents	Budget
Total		200
1	Survey and studies on resources and environment	30
2	Formulation of plan for environmental control and restoration	30
3	Building up of monitoring system	50
4	Establishment of nature reserve	30

5	Formulation of plans for resource development and utilization	15
6	Publicity, education and training	20
7	Organization and coordination	10
8	International cooperation	15

_Work plan

The Project will be implemented in three stages for 2 years (Table 17).

Table 17 Work plan for restoration and conservation of mother of pearl shell resources

Tasks	Schedule
Resource survey, environmental condition survey, establishment of nature reserve, formulation of nature reserve development plan and plan for resource development and utilization	1st stage (10working months)
Formulation of environmental control and restoration plan. Environmental pollution control and restoration in the coastal waters. Formulation of environmental pollution monitoring plan and establishment of control and monitoring network. Carrying out technical training of managers and formulation of publicity and public education plan.	2nd stage (10 working months)
Establishment of a nature reserve for mother of pearl shells and the establishment and operation of the institution for management.	3rd stage (4 working months)

7.4.7 Risk assessment

The project has relatively small risks in the implementation. The major risks come from the understanding and support of the public. It is understandable that the

establishment of the nature reserve will have impact on the distribution of industrial and agricultural production, modes of production and life and technical level. This includes the bondages on behaviors and increase of production and operation costs. This needs the wide support from the coastal governments and the public and their acknowledgement and understanding of the importance and urgent ness of the sustainable utilization of natural resources. Otherwise, this will bring about difficulties for the implementation of the Project. However, as we understand, Beihai People's Government is attaching more and more importance to the conservation of scientific utilization of mother of pearl shells and has taken many measures to improve environmental quality from which some achievements have been scored. In addition, thanks to continuous publicity campaigns, the public has increased the sense of sustainable utilization of natural resource. Therefore, there are few risks for the implementation of the Project.

7.5. **Ecological Monitoring in Sanya Coral Reef Nature Reserve**

7.5.1 Profile

The Sanya State-Level Coral Reef Nature Reserve was set up upon the approval of the State Council in 1990. The Nature Reserve is situated at the coastal waters of Sanya City in the south of the Hainan Island _109°20_50__109°40_30_E_18°10_30__18°15_30_N)_covering a total area of 63km$^{2.}$ This is composed of three parts, the coastal waters from the Luhuitou Peninsula to Cape Yulin, the waters around the east and west Maozhou Island and the Yalong Bay, mostly in the sea , partly with islands and coastal land.

The major objects under protection are the reef-builder corals, soft coral and other corals in the coastal waters, including marine ecological environment of coral reefs and associated organism. The nature reserve has 110 species of reef builder, over 30 species of soft corals and other non-builder corals, mostly distributing in the waters shallower than 10 m along Sanya City. They are well developed in the waters around the capes of a bay and around an island. In the waters of 1_2m deep, the best coverage of coral may be over 70% . The coral

reefs in Xiaodonghai, Dadonghai and Yalong Bay are the best in the Nature Reserve.

After its establishment, strict management and prot4ction measures have been taken which have brought the coral reefs in coastal Sanya under effective protection. However, due to limits of means of survey and monitoring, the conditions of baseline and change tendency of the coral reefs and the associated ecological environments in the Nature Reserve are well understood. This has reduced the scientific, foreseeable and well-planned management of coral reef resources and its ecological environments. It is therefore imperative to carry out monitoring on the natural factors of coral reefs and the ecological environment and the social factors of impact from human activities, so to provide scientific basis for the management of the Nature Reserve.

7.5.2 Objectives

- Profile of the coral reef resources in the Nature Reserve
- Profile of the ecosystems and biodiversity associated with coral reefs
- Providing references to the effects of protection and management of coral reefs in the Nature Reserve
- Providing basis for planning and the sustainable utilization of natural resources in the Nature Reserve
- Providing basis for the integrated management planning of the Nature Reserve

7.5.**3Implementation of the Project**

7.5.3.1Contents of monitoring

7.5.3.1.1 Monitoring of natural factors in the Nature Reserve

- Seawater quality monitoring

The growth of corals is closely related with its water environment. The major parameters under monitoring include salinity, $_{p}$H, DO, COD, PO_4-P, NO_3-N, NO_2-N, NH_4-N, suspended particles_water color and transparency.

- Bottom soil monitoring
- Hydrological monitoring ,including monitoring of Tides, waves and currents

Carry out statistical analysis of the characteristics of meteorological wave and tidal parameters by making use of the observation data of nearby permanent ocean station. Two field observations of currents are recommended.

7.5.3.1.2 Coral and ecological monitoring

- Common species and dominant population of corals and their changes
- Range of distribution of coral reefs and their changes
- Density of coral reefs
- The state of growth of coral reefs is the key parameter of monitoring
- Major marine organism and dominant communities associated with corals
- Population biomass and density of coral reefs
- Diversity indexes in coral reef waters
- Features of spatial biological distribution and structure

7.5.3.1.3 Human activities and socio-economic profile associated with coral reefs

- Monitoring of the tourists entered the Nature Reserve_number of people, composition structure, major activities, major areas entered, understanding of the Nature Reserve and environmental education received_.
- Monitoring of development activities in and around the Nature Reserve(fishing, aquaculture, farming , processing industry and tourism_.
- Monitoring of major enterprises using natural resources
- Monitoring of unfavorable impacts on coral reefs and sea area from human activities_property of activity, form of impact, degree of impact , results and tendency of impact_

7.5.3.1.4 Development of data bank and management software for long term ecological monitoring

- data collection
- data key-in
- data analysis and processing
- establishment of data bank
- Compilation of software for enquiry, indexing and GIS management

7.5.3.2Monitorin scheme

7.5.3.2.1 Distribution of monitoring stations

The monitoring station of water quality is distributed in lattice, 6 stations in the waters from Luhuitou Peninsula to Cape Yulin, and 8 stations in the coastal waters of east and west Maozhou Island and 8 stations in the Yalong Bay. In

the above three areas, each area is set with a continuous observation station for sampling every two hours.

Current monitoring station is set up each in the three areas.

The monitoring of coral and its population is carried out inside the Nature Reserve , with the core zone and the buffer zone with corals as the key areas. Since corals are distributed in waters shallower than 20 meters, underwater camera and transects of quadrants are set. 2 to 3 stations in each of the areas.

The monitoring stations for human activities and socio-economic conditions are set at the main entrance to the Nature Reserve and the tourism zone, the area with more tourists and the areas that use more natural resource of coral reefs. Three to four stations are recommended.

7.5.3.2.2 Monitoring cycle

The Project lasts for 2 years. Monitoring cycle is decided by the contents of monitoring.

For the conventional monitoring of natural condition and the parameters with direct readings such as water temperature, salinity and tidal level, 2 records are made every day, and such as sea currents and bottom soil, one record is made every month. For the parameters that need sampling and analysis, two measurements are made every month. Sudden or abnormal events , such as red tides, typhoon , sustained high or low temperature and pollution accidents, timely monitoring and report are required.

Monitoring of coral reef ecosystem its biological population is made one bimonthly. For sudden and abnormal cases, timely monitoring and report are required.

The monitoring of impact on coral reefs from human activities may be made in accordance with the property and strength of the activates. The monitoring of general socio-economic conditions may be made one every season. The monitoring of events with significant impact should be made and reported timely.

7.5.3.3Monitoring means

- Monitoring of seawater quality_Samples are collected with water samplers from different levels at the same time from various monitoring stations and sent to the lab for analysis and recording.
- Sea current observation_25 hours of continuous observation at each

station, readings from the direct reading current meters are made at the same time every other hour.

- Monitoring of coral reefs_Use underwater camera and quadrants to photo , measure and record species of corals, distribution range ,density, coverage and degree of damage of coral reefs at various transects. 1 to 2 fixed monitoring stations are set at each of the three areas, in which continuous underwater cameras are used to record the growth, reproduction and damage of the corals.
- Monitoring of biological communities in coral reefs_Use underwater camera and quadrants to photo , measure and record species, biomass and density of major organisms at various transects. 1 to 2 fixed monitoring stations are set at each of the three areas, in which continuous underwater cameras are used to record the growth, reproduction and damage of the organisms.
- Monitoring of human activities and socio-economic conditions. Forms of enquiry tables, questionnaires, field visits and data collection is used.
- Analysis, processing, storage, key-in, transmittance and indexing of the monitoring data.

7.5.3.4 Form of monitoring results

- original records of monitoring
- data bank of monitoring data
- Image and photos
- Monitoring and analysis report
- Maps and figure from analysis
- Other data and information
- Enquiry and indexing software

7.5.4 Budget_Unit_Thousand USD_

Terms	1st year	2nd year	3rd year
Data collection	3.0	2.0	5.0
Training of monitoring staff	6.0	4.0	10
Purchase or rent of monitoring facilities	30	20	50
Monitoring of natural conditions	10	10	20

Monitoring of coral reef state and biodiversity	30	20	50
Monitoring of human activities and associated socio-economic conditions	10	10	20
Data key-in	5.0	5.0	10
Establishment of data bank and data analysis	5.0	5.0	10
Compilation of GIS software for monitoring and management	10	15	25
Determination and analysis of samples	10	10	20
Total	**119**	**101**	**220**

7.6. Environmental education in Sanya State-Level Coral Reef Nature Reserve

7.6.1 Background

The Sanya State-Level Coral Reef Nature Reserve is the first group of state-level marine nature reserves approved to be set up by the State Council and the unique nature reserve of coastal coral reefs in China. The Nature Reserve has superiority in both natural resource and geographical location. The Nature Reserve protects reef-builder corals, soft corals, coral reefs and the ecosystems therein. The waters along Sanya City have the best development of coastal reef builder corals. There are over 110 species reef-builder corals, over 30 species of soft corals and other non-reef builder corals in the Nature Reserve. Coral reefs play important role in stabilizing the coast, maintenance of marine biodiversity and fishery production on one hand and constitute unique underwater landscape for the development of tourism on the other hand .

Before the establishment of the Nature Reserve, there happened coral reef damage case due to lower sense of the local people in coral reef conservation marine ecological conservation. Since the Nature Reserve was set up in 1990 upon the approval of the State Council, significant results have been achieved from effective conservation and protection. In the processes of law-enforcement and management, the Nature Reserve has been carrying out environmental protection education for the tourists and pupils from the primary and secondary schools, including the creation of

Display Room of Coral Reef Ecology, Marine Pop Science Education in the primary and secondary schools, coral reef conservation education among the tourists and Science Summer Camps. Marine environmental protection education has become an important part of management work in the Sanya State-Level Coral Reef Nature Reserve in recent years.

7.6.2. Objectives

Environmental protection education is a basic and long-term task for the communities and provides a good social foundation and atmosphere for the protection and conservation of natural resources and environments. It has a profound influence on the management of the Nature Reserve and rational development and utilization of natural resource.

The environmental protection education is an important aspect of work in the Sanya Nature Reserve, and an important work for management of nature reserves in the Sino-US Cooperation. The objectives of the task are by taking the Nature Reserve as the base and by combining resource conservation and management, to give full play of the superiorities of geographical location, natural resources and environment of the Nature Reserve in environmental protection education. Various forms of education with rich contents are provided for the key groups of people such as pupils from primary and secondary schools. It is intended to have more people involved in marine environmental protection education campaigns so to enlarge the social influences of the Nature Reserve and turn it into the window and bridge for the public participation in marine ecological conservation. It is intended to win more people to support and participate in marine ecological conservation . so to realize the win-win strategies of sustainable development in marine resource protection and the development of the Nature Reserve and make the Nature Reserve a demonstration site in building Hainan into an ecological province.

7.6.3.major contents for environmental education in the Nature Reserve

7.6.3.1. Environmental education for pupils from primary and secondary schools

- Basic knowledge of marine biology
- Basic knowledge of marine ecology
- Basic knowledge of physical marine environment
- Correlation between marine organisms and environment
- Significance in protecting marine environment and resources
- Facts about the Sanya State-Level Coral Reef Nature Reserve

- What ever a pupil of primary or secondary schools can do for the conservation and protection of marine resources and environments

Form of education

- Pop science lectures inside the school
- Out of school lectures
- Organization of groups for marine environmental protection
- Summer camps and winter camps
- Communications and consultation about marine environmental protection
- Field visit of the Nature Reserve
- Tests and contents on sea knowledge
- Guiding pupils to make articles used in environmental protection
- Set up of demonstration site for environmental protection education in the Nature Reserve for the primary and secondary school pupils

7.6.3.2.Marine environmental protection education for tourists

- Basic facts of marine environmental protection in Sanya City and in the Sanya State-Level Coral Reef Ecosystem Nature Reserve;
- Zoning of the Nature Reserve and its major management activities
- Range , limits of ecotourism zone and limits on tourism activates
- Laws, regulations and policies concerning marine environmental protection
- Basic knowledge about marine ecological and environmental protection
- As a tourist, how to support and coordinate with the management work in the Nature Reserve and how to participate in the management activities once it is needed.

Form of education

- Handouts of environmental protection education
- Environmental education by tourist guides
- Tourist education center
- Consultation and comments feedback

7.6.3.3. Environmental protection education for tourism companies

- Basic facts about Sanya City and the Nature Reserve
- Zoning of the Nature Reserve and its major management activities
- Range and limits for ecotourism and limits for tourism activities
- Laws, regulations and policies for marine environmental protection
- Basic knowledge about marine ecology and environmental protection

- As a tourism company, how to support and coordinate with the management work in the Nature Reserve and how to participate in the management activities once it is needed.
- How should a tourism company educate the tourists with knowledge about environmental protection

Form of education

- Lectures of environmental education for managers of tourism industry
- Environmental education training courses for servicemen in tourism industry
- Education and consultation for tourist guides
- Environmental education materials displayed in hotels, tourism companies and tourism shopping center

7.6.3.4. Marine environmental education for the public

1_Who to be educated

- fishermen
- citizens
- staffs of government organization and other institutions

2. What to be educated

- Basic facts about Sanya City and the Nature Reserve
- Laws, regulations and policies concerning marine environmental protection
- Basic knowledge about marine ecology and environmental protection
- As a citizen, how to support and coordinate with the management work in the Nature Reserve and how to participate in the management activities once it is needed.

3 Form of education

- Participate in ecotourism and management activities in the Nature Reserve
- Publicity campaigns in the Environment Day
- Advertisement for public benefits in media
- Visit tourist education center
- Environmental education consultations

7.6.3.5. Infrastructure building for environmental education

1_ Training station for managers of environmental education

2_ Tourist education center

_1_ Display room of marine specimens_more on significance of ecological conservation_

_2_ Museum of Marine Ecology

_3_ Multi-function Hall for Ecological Education(slides, video, VCD, pictures, overhead, lecturers, workshops and small experiments_

_4_ Labs

3_ Education facilities for the public

_1_ Board for education and publicity

_2_ Ecological memorial forest

_3_ Advertisement Column for environmental education

7.6.4 Work plan

The project will be accomplished in 2 years_the first month refers to the month when the project is launched_

Tasks	Months for accomplishment
Formulation of operation scheme of the project	1-2
Making of education boards for coral reef conservation	2-6
Compiling of environmental education materials	4-7
Training of staffs for education and management	4-8
Environmental education lectures for pupils from primary and secondary schools	5-10
Lectures for tourism industry and tourists	5-10
Field trips for ecological education in the coral reefs	10-20
Construction of Tourist Education Center	12-22
Workshop on environmental education	18-24

7.6.5 Budget_Unit: thousand USD_

Terms	First session	Second session	Total in two years
Boards for coral conservation education	3.0	2.0	5.0
Environmental education materials	2.0	1.0	3.0
Training of management personnel	5.0	2.0	7.0
Environmental education lectures for middle and primary school pupils	2.0	3.0	5.0
Environmental education lectures for industries and tourists	2.0	3.0	5.0
Eco-tourism education activities	5.0	5.0	10
Capacity building of tourism center	10	3	4

Exchange of environmental education specialist	5.0	1.5	2
Total	**34**	**61**	**95**